

FIRE PREVENTION INSPECTION EFFECTIVENESS

Fire Prevention Inspection Effectiveness –

Creating an Assessment Methodology for the Cary Fire Department

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another.

Signed: _____

Abstract

The problem statement for this research indicated that the Cary Fire Department had no methodology to evaluate its fire inspections in order to assess whether those inspections reduced fire incidents, deaths and injuries.

The purpose for this research was to identify an appropriate methodology to assess fire inspections effectiveness and report that information to stakeholders.

The author used descriptive research to identify methodologies that assessed and communicated effectiveness of fire inspections. Literature reviews, interviews and a survey answered the following questions: (a) How do organizations that utilize inspections for loss prevention define and measure their effectiveness?, (b) What national standards or academic practices for assessing fire inspection effectiveness exist?, (c) How do fire departments typically define and measure the effectiveness of fire inspections?, (d) How do these departments assess effectiveness and report results?, and (e) What barriers to implementing a methodology to assess fire inspection effectiveness exist within Cary Fire Department?

The author reviewed applied research projects, journal articles, Internet articles and texts. In addition, the author surveyed other fire departments and conducted interviews with academic experts to identify methodologies used to assess fire inspection effectiveness and assessment methodologies for other loss prevention activities. Lastly, the author conducted an interview with Cary Fire Department staff to identify any barriers to evaluating fire inspection effectiveness.

Research findings included (a) methods that simply reported performance measures, (b) methods that reported performance measures and compared changes over time, and (c) no methodology for assessing effectiveness. Moreover, findings revealed that establishing direct

causality between inspections and a reduction in fire incidents is not necessary; one only needs to establish a plausible connection for that outcome.

Recommendations included (a) defining fire inspection effectiveness for the organization, (b) developing specific performance measures for that definition and (c) creating a regularly published report for stake holders.

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Specifically, the problem statement of this research is that presently, the Cary Fire Department (CFD) has no methodology to evaluate its fire inspections in order to assess whether those inspections mitigate the occurrence of fires and hazardous conditions in order to safeguard the public. Moreover, the inability to assess and report the effectiveness of fire inspections creates a barrier to securing additional funds to meet a growing fire incident rate and fire prevention inspection workload.

To that end, the purpose of this research is to identify and implement an appropriate method to assess the effectiveness of fire inspections in order to determine the program's viability and report that information to stakeholders.

In an effort to satisfy the purpose of this research, the author will use descriptive research to identify a methodology to assess and communicate the effectiveness of fire inspections conducted by the Cary Fire Department. For research question #1, "How do organizations that utilize inspections for loss prevention define and measure their effectiveness?" the author will conduct literature reviews and conduct a survey (See Appendices A and B) to identify any similar loss prevention practices and performance measures for effectiveness in organizations other than fire departments. For research question #2, "What national standards or academically promoted practices for assessing fire inspection effectiveness exist?" the author will conduct a literature review of nationally recognized standards and texts and will interview academic experts to identify recognized practices. For research questions #3, "How do fire departments typically define and measure the effectiveness of fire inspections?" and #4, "How do these departments assess effectiveness and report it to others?" the author will conduct a survey (See

Appendix C) of other fire departments in order to identify their definition of inspection effectiveness, determine how they measure and assess inspection effectiveness and report the author's findings. For research question #5, "What barriers exist to implementing a method to assess fire inspection effectiveness in the Cary Fire Department?" the author will conduct an interview (See Appendix D) with Town of Cary Fire Department staff and conduct a literature review to identify barriers to implementing a method to assess fire inspection effectiveness for the Fire Department.

Background and Significance

The Town of Cary, North Carolina Fire Department serves a community of 132,000 residents situated in central North Carolina and encompasses more than 53 square miles of jurisdiction. Fire Department staff responded to 6,204 calls for service and conducted 5,119 fire prevention inspections in fiscal year 2007 (Final Report on City Services 233).

At two structural fires per 1,000 residents, the Town of Cary has the lowest structural fire incident rate of any municipality in the State of North Carolina. (Final Report on City Services 232). It is unclear however what factors contribute to this low fire incident rate. One might reasonably assume that fire prevention inspections have an inversely proportional effect on the incidence of structural fires in our municipality. Presently, the Cary Fire Department does not have a methodology to assess the effectiveness of its fire inspection program and to what extent the program reduces the incidence of fires, prevents the loss of human life, or limits or reduces property damage.

Beginning in the early 1970s, the Cary Fire Department Risk Management Division conducted annual fire prevention inspections in all business occupancies. Fire Inspectors were trained according to National Fire Prevention Association standards and the Town adopted the

Fire Prevention Code from the Southern Building Code Congress. The Fire Department self-mandated this program and there were no performance guidelines mandated by the Town Administration. Inspecting all business occupancies annually and responding to fire code complaints served as the only program objectives. These program parameters worked well through the early 1990's until the Fire Department initiated budget requests for additional staffing and resources in order to meet the annual inspection workload. It was during this period that the nation's second worst industrial fire would reshape the way North Carolina municipalities including the Town of Cary would conduct fire prevention inspections.

On September 3, 1991, a hydraulic line ruptured and ignited a fire in the Imperial Foods Chicken Processing Plant in Hamlet, North Carolina. The intense fire quickly isolated employees from exits and plant management routinely had locked many fire exits in order to prevent employee theft. Once the fire was extinguished 25 employees had perished and another 54 employees suffered injuries of varying degrees (USFA Report 2). The subsequent After-Action Report indicated that the Hamlet Fire Department and North Carolina Department of Occupational Safety and Health had never inspected the Imperial Foods Plant during its eleven years of operation.

As a result of the Imperial Foods fire, the North Carolina General Assembly (NCGA) mandated a statewide fire prevention code, fire inspector certifications and a minimum fire inspection frequency schedule for all local government units. The State adopted the International Fire Code. In addition, the State mandated fire inspector certifications and a minimum fire inspection frequency schedule which were based on the level of fire risk for each occupancy type. One programmatic aspect the General Assembly did not address was a method to evaluate fire inspection effectiveness. For the Cary Fire Department, these mandates required a change

in fire prevention code from the Standard Fire Code to the International Fire Code. Moreover, whereas Cary fire inspectors had previously completed National Fire Protection Association training, the State did not require a certification for fire inspectors. Because of its capacity to do so, the Fire Department's Risk Management Division continued to inspect all occupancies annually even though this exceeded the State's minimum inspection frequency schedule of 1, 2 and 3-year inspections for various occupancies.

Given the absence of any means to evaluate the effectiveness of its fire prevention inspection program, the Cary Fire Department could not demonstrate whether fire inspections conducted by staff accomplished the intended primary goal of preventing fires as well as the loss of life associated with those fires and secondarily, reducing fire damage when fires do occur. In addition, the fire prevention inspection workload increased as the number of properties within the Town's jurisdiction increased. Without a generally accepted method to evaluate fire inspection program effectiveness, the Department's ability to request and receive funding for staff and resources was greatly compromised. As in many other communities, the demand for funding for perceived needs and wants of the community far outweigh actual available funding. This resource dilemma has resulted in tremendous pressure on public administrators to not fund programs when they fail to demonstrate resources are producing intended outcomes.

Since 2001, the Fire Department has made six budget requests for additional regular fulltime staffing for its Risk Management Division in order to maintain pace with an increasing workload and compliance with the NC Fire Inspection Schedule. Requests for the regular full time positions have been denied; however, funding for part-time inspectors has been awarded for the past three years. Efforts from this part-time staff have maintained the Division's ability to comply with the inspection frequency schedule. However, without the means to measure and

report on the effectiveness of the fire prevention inspection program, the Cary Fire Department is unable to answer questions about how effective the program is and whether additional resources to meet workload demand are warranted.

The aforementioned research problem is connected to the EFOP course, Leading Community Risk Reduction (LCRR). LCRR's primary goal is to develop leaders in comprehensive multi-hazard community risk reduction. The course identifies code enforcement, prevention related ordinances, and building and systems plans review as effective community risk reduction strategies. Specifically, the research problem of establishing a definition and method for evaluating fire inspections to insure that fire inspections meet their objectives is aligned with LCRR Unit 6: Evaluating. This alignment is further underscored by examining Unit Six's terminal objective, "Given evaluation information from a community risk reduction initiative, the students will be able to modify the risk reduction initiative to improve its effectiveness." and the unit's first three process objectives. Unit Six process objectives include (a) Evaluate the results of a risk reduction initiative to determine if the objectives have been achieved, (b) Report the results of evaluation to key officials, department staff, community partners, and target audiences, and (c) Modify a risk reduction initiative based on the results of evaluation (Leading Community Risk 15).

In addition to alignment with LCRR Unit Six, the research problem further aligns with the 5-year United States Fire Administration (USFA) operational objectives to reduce the loss of life from fire by 15 percent and secondly, to develop a comprehensive multi-hazard risk reduction plan for 2,500 communities (Leading Community Risk 15).

Literature Review

Given that fire code enforcement through the application of fire prevention inspections neatly qualifies as a regulatory activity of local governments, the book, *The Regulatory Craft – Controlling Risks, Solving Problems, and Managing Compliance*, by Harvard Kennedy School of Government Professor Malcolm Sparrow offers a candid perspective of how regulatory agencies should address the political, customer service and process challenges of regulatory activity.

Drawing on the parallels that conducting fire prevention inspections based on a prescribed code is a regulatory activity implemented to reduce the occurrence of fires and subsequent injuries, deaths and property damage, Sparrow claimed that if the central business of regulatory agencies is really controlling risks such as that described for fire prevention inspections, then business results would mean “risks controlled” (Sparrow 281). In light of Sparrow’s contention and in the context of fire prevention inspections, the author would contend that the business results or fires prevented or fire related deaths or injuries prevented would serve as the measure by which the agency is evaluated. To that end, Sparrow asserts that because risk control or the act of preventing an activity, for this author’s purpose and research fires prevented or deaths or injuries prevented, is problem specific then proving causality for the purpose of this research “Did the inspection prevent the fire or deaths or injuries?” is usually impossible. Therefore, measuring prevention is difficult to support over the long term (Sparrow 289). With these arguments, Sparrow seemingly creates a number of opportunities for the regulator to simply ignore the need to evaluate the agency’s ability to perform its central business.

Sparrow supports the argument that causality is difficult to prove at least not convincingly enough to satisfy customary academic standards by creating a context more easily understood and appreciated by practitioners than by academics. Sparrow (2000) states:

Regulatory agencies should not feel obligated to prove causality. They should be content to demonstrate publicly their ability to focus on specific risks, to design and implement creative solutions, and to determine when the risk was abated sufficiently to permit them to move on to other priorities. (p. 288)

The parallel here is that regulatory agencies like fire prevention divisions exist with a central business purpose, to reduce the occurrence and magnitude of fires. Therefore, the fire prevention division's activities and reports should focus on solving problems within that purpose and not on devoting inordinate resources to prove their activity was the proximate cause for controlling that risk. Sparrow fittingly caps this argument with the reminder that perhaps the most important point about function-specific performance is that credit for outcomes can be claimed only when the outcome results unambiguously and directly from the actions of one function alone – which is rare (Sparrow 282).

When demonstrating results of a regulatory agency, Sparrow's ideas center on five inescapable truths: (a) outcome measures are problem specific and therefore difficult to aggregate, (b) proving causality is usually impossible at least not to academic standards, (c) credit cannot be assigned to an individual function, (d) prevention is not measurable and is difficult to support over the long term, and (e) measuring compliance rates also presents challenges (Sparrow 285). With respect to all of the literature reviewed during this research, Sparrow's "difficulties" served as a litmus test for other processes, concepts, or methods

discovered in the research in order to determine those strategies that would likely produce the best results for the Cary Fire Department.

Because fire prevention inspections serve as a risk and loss prevention strategy for communities, this research examined other loss prevention strategies that incorporate prevention inspections to determine their methods to define and assess inspection effectiveness. The Occupational Safety and Health Administration (OSHA) conducts a variety of inspections in the course of their mission to prevent occupational injuries and illnesses in the same manner that fire departments conduct fire prevention inspections in order to prevent the occurrence of fires and minimize the resulting damage (Gray 571). OSHA Compliance officers typically conduct programmed inspections or complaint based inspections. Programmed inspections target various randomly chosen work places and complaint-based inspections target workplaces where an employee or union official complain about a potential workplace safety violation or condition. Once again, this work activity closely mirrors fire inspections conducted on a regular schedule or in response to a complaint about a hazard or condition in a public place.

In their 2005 article, *The Declining Effects of OSHA Inspections on Manufacturing Injuries, 1979 to 1998*, Wayne Gray and John Mendeloff assess inspection effectiveness by virtue of changes in statistical data identifying inspection types, numbers of injuries, and loss-time categories covering various time periods. For example, the Gray – Mendeloff analysis provided evidence of a substantial decline in the measured impact of OSHA inspections on injuries by examining Federal OSHA injury data. They compared data for three concurrent time periods from 1979 through 1998, for inspections that levied penalties compared to inspections that did not levy penalties (Gray Mendeloff 579). Gray and Mendeloff produce four additional evaluations completely based on statistical analysis based on the aforementioned data. This data

originated from Federal and State OSHA agencies and represented several multi-year time periods. In this example, a decline in the effectiveness of OSHA inspections was demonstrated by examining changes in data directly tied to OSHA's mission to prevent injuries and regulatory activities such as conducting inspections and assessing penalties. Drawing upon the parallels of the OSHA injury prevention inspection and a fire department's fire prevention inspection, one could reasonably assume and employ that a statistical analysis of inspection data and its variance over time would produce an assessment on the effectiveness or ineffectiveness of a fire prevention inspection program.

In perhaps one of the more interesting articles discovered during the literature review, a 1995 speech announcing a "New OSHA – Reinventing Worker Safety and Health" by former President Bill Clinton offered a portent of how the public should judge OSHA on its effectiveness at eliminating workplace hazards and reducing injuries and illnesses. President Clinton stated that OSHA needed "common sense enforcement with results, not red tape". The Agency's performance would be evaluated on the basis of data and actual results achieved, not just the number of agency activities (Clinton 7). Historically, OSHA had reported various activity levels such as inspections conducted and penalties assessed as measure of effectiveness even though neither directly relate to the Agency's mission of reducing fatalities, injuries and illnesses. One of OSHA's principles to reinventing itself was to focus on identifying strategies to correct the underlying causes of hazardous conditions in order to reduce worker exposure at a source (Clinton 8). The author found other sources during the literature review that focused on this concept of problem solving or correction and reporting those initiatives rather than reporting activity or workload as measures of effectiveness.

In David Weil's 2005 study, "Making OSHA Inspections More Effective", effectiveness is evaluated by a different set of criteria. These criteria center on the construction industry as it typically has the most reported deaths and injuries of any other industry regulated by OSHA (Weil 2).

In 1977, the US Supreme Court ruled in *Marshall v. Barlow's Inc.* (429 U.S. 1347, 97 S. Ct. 776) that OSHA use an objective and documented basis for selecting targets (workplaces) for programmed or planned inspections. OSHA needed to demonstrate use of specific neutral criteria to target workplaces in order to prevent arbitrary or abusive selection processes by agency personnel (Weil 3). This ruling, known as Barlow's Rule along with a 1987 Department of Labor Inspector General's investigation prompted OSHA to automate the targeting process. The resulting targeting procedure uses construction permitting data collected by F.W. Dodge Inc. and statistical models to establish the set of construction projects subject to inspection. While the Dodge targeting process complied with the Barlow ruling, Inspectors found that projects identified for inspection often had not started or construction was substantially complete. Because the construction process is extremely dynamic with ever-changing states of completion, timing the inspection of construction projects during peak activity periods is critical to identifying those work processes or workplace conditions most likely to produce worker injury and death.

In his article, Weil's premise to making inspections more effective is to alter the targeting process to focus OSHA's limited resources to specific areas that promise the most return on its mission to preventing workplace illness, injuries and fatalities. Weil identifies three major principles to base inspection targets upon in order to maximize limited resources, the number of inspectors or Compliance Officers, against the inspection workload, which is the number of

ongoing construction sites. Specifically, these principles include: (a) focus target at the project level for those specific projects at periods of greatest risk, (b) focus on prospective risk to classes of workers with the greatest occupational risk and (c) consider efficacy in choosing inspection targets by focusing on those employers more inclined to change unsafe conditions and behaviors.

The Dodge system would capture injury and illness rates for the altered targeting process, but any change in these rates for a particular project or employer would not serve as the basis for establishing whether the inspection was effective or not. Weil suggested that changes in injury and illness rates alone could not serve as the measure of effectiveness because other potential factors outside of OSHA inspection activity exist that likely could affect rates. Instead, one would assess effectiveness of the new targeting process and subsequent inspections by analyzing the direct effect of the inspection itself and indirectly through deterrents for those workplaces not inspected (Weil 21).

Interviews with noted experts provided clarity and added context for the research questions. One interviewee was David Ammons, PhD, who is an Albert Coates Professor of Public Administration at the University of North Carolina (UNC), School of Government. Dr. Ammons has authored six books on local government management. Three of Ammons' books relate directly to local government performance, accountability for performance, and decision making all based on municipal benchmarking and performance measurement. Dr. Ammons served as the original project manager for the annual North Carolina municipal performance measurement project, a joint initiative between the UNC School of Government and the North Carolina Local Government Budget Association. His interests include public administration; productivity improvement in local government; performance measurement; benchmarking. Appendix B contains the questions posed by the author during the interview.

When asked the first research question, “How do organizations that utilize inspections for loss prevention define and measure their effectiveness?” Dr. Ammons replied, “It doesn’t feel satisfying when measuring things that do happen, when one is trying to measure things that don’t happen”. Further, to consider a loss prevention activity successful, one would want to see a reduction in the rate of occurrence of the loss activity and benchmark your measure against what others are achieving. For the purposes of this research, that definition seems plausible as fire inspection and incident data are readily collected by many if not all fire departments engaged in both activities. As previously discussed by Sparrow, Ammons acknowledges the issue of causality with the inspection and change in incident rate. Ammons readily cedes that the incidence of fires is an “imperfect gauge”, but covers the measurement shortcoming by posing the question, “Isn’t that the purpose of the inspections – reducing the incidence of fire?” This statement follows the Sparrow logic by not focusing so much attention on proving conclusive causality, but on reporting the central business function of the fire inspection group.

When asked to contrast another Sparrow difficulty, “outcome measures are problem specific [for loss prevention activities] and therefore difficult to measure”, with the statement “you can’t measure what I do” found in his book, *Municipal Benchmarks*, in which Ammons responds in text by stating that “rarely is it impossible” (Ammons 18) to measure performance, Ammons contends that, “it’s difficult, but rarely impossible” and he [Sparrow] says, “it’s difficult or exceedingly difficult”; therefore the ideas are not at odds with one another, but essentially illustrate the same argument.

Again, Sparrow and Ammons appear in concert with one another when evaluating performance for loss prevention organizations. Reporting mechanisms and their measures should provide commensurate value for the organization. Difficulty creating or utilizing any

measurement criteria should be weighed against the value provided by that measure. Ammons acknowledges the barriers faced by local governments when implementing performance measurement systems. Often, these systems incur significant costs and require a certain level of staff sophistication to maintain and utilize. Typically, only those organizations that hold accountability for performance as a high priority or those individuals that perceive accountability as part of their professional obligation engage in performance measurement and benchmarking activities. When they do, Ammons says the mechanisms should not overly burden the organization.

One final effort to identify similar methods for evaluating risk reduction activities led the author to the University of North Carolina, School of Public Health, Injury Prevention Research Center (IPRC). The author conducted a round-table interview with Dr. Jim Porto, Dr. John Staley and Maryalice Nocera, MS. The interview centered on evaluating the effectiveness of interventions for injury prevention initiatives, much like an inspection serves as an intervention for a potential fire incident that might result in personal injury, death or property damage.

As it has been discussed by Sparrow and Ammons, the question about the importance and ability for evaluators to establish causality for an intervention was posed to the group. Unequivocally, the group responded by stating that causality is the most common problem for evaluators when assessing the effectiveness of public health initiatives. Dr. Porto added that evaluations are either outcome or process related, with process evaluations as the most common and easiest to conduct. The reality for most outcome evaluations, such as evaluating fire prevention inspections, is that the evaluator will at best strive to make only a plausible case that a fire prevention inspection was a contributing factor in the reduction of fires. Porto supported his comment by adding that numerous factors outside of the inspector's control will influence the

probability that a fire might or might not occur. With multivariate factors, the reasonable assumption that a fire prevention inspection is an appropriate and responsible preventive activity presupposes that it will result in a reduction of fires and subsequent reduction in injury and death rates as well as property damage.

With that overarching statement about program evaluation and its reality, the panel discussed two evaluation methods used in public health initiatives where one assumes the purpose of an initiative is warranted and good public policy and not premised on demonstrating causality but on results that simply make a plausible case regarding whether initiative was effective or not.

Using process evaluation and examining the fire inspection process itself, the evaluator would assess the inspection process to insure inspectors are trained and qualified. Evaluators would ensure inspectors are using the appropriate inspection process and referencing the fire code appropriately, noting code violations and prescribing the appropriate corrective action order to the responsible party and re-inspecting the property to ensure that any violation was corrected. Assuming the purpose for making inspections is warranted and therefore good public policy, one would benchmark fire incident rates and violation compliancy rates with similar agencies and conclude whether their activities were effective or not.

A second evaluation method to determine effectiveness based on outcomes is to consider the total cost for fire incidents compared to the total cost of providing inspections. In order to make this comparison, one would conduct a retrospective analysis of the number and types of violations cited by the inspection group. Of all the violations noted, one would select those violations deemed most likely to result in a fire if not abated and establish a sensitivity analysis with 3 to 4 probabilities that identified the likelihood of a variable number of fire incident rates.

In addition to this retrospective analysis, the evaluator would establish the average cost for fires in terms of fire loss and fire department operational costs resulting from these incidents and apply those costs to the various probabilities established in the sensitivity analysis. Dr. Porto termed this “counterfactual thinking” where the evaluator is theorizing what would likely happen if one did not implement the intervention. In this case, the evaluators would estimate the number of additional fires and associated costs as a result of not conducting fire prevention inspections. The cost-benefit analysis and subsequent conclusion by the evaluator to deem the inspections effective or not is based on the evaluator assessing the cost of preventing those fires by virtue of the inspections compared to the cost of the fires likely to occur as a result of not conducting inspections. Of course, one would likely expand the cost of the fires to include injury and death costs assuming some probability for those consequences exist.

In summary the literature review conducted in response to the first research question, “Identify any similar loss prevention practices and their effectiveness measures in organizations other than fire departments.” identified a number of effectiveness evaluation methods from various loss prevention disciplines that range from a statistically based retrospective data analysis as presented in the Gray – Mendeloff article to a process evaluation model as presented by Weil which focuses on targeting the most rewarding site for inspection. It includes a visionary presidential expectation of judging OSHA’s success on eliminating hazards and reducing injuries not on workload and activity measures. From the academic perspective that influences local governance and public policy, the review discovered Sparrow’s difficulties associated with evaluating the results of regulatory agencies and Ammons’ thoughts that although some measuring and evaluating processes present some difficulties rarely is the process impossible. Lastly, the review revealed that public health initiative evaluators face similar

challenges evaluating the effectiveness of intervention programs design to reduce injury, disease, and violence. Almost all methods addressed the concept of causality and reflected on its significance with the overwhelming idea that with respect to loss prevention evaluation, like the thesis of this research, the evaluator should not overly concern himself or herself with attempting to prove causality. One should simply strive to present a plausible case for the evaluation.

In his interview, Dr. Ammons stated unequivocally that to his knowledge a national standard or specific academically promoted practice for assessing fire inspection effectiveness does not exist. In fact, he requested that if the author found one, to please let him know. Based on the findings of the research thus far, it appears no particular model exists because the definition for effectiveness within the fire service and greater loss prevention industry is either ambiguous or is based upon local needs. For example, cost may define effectiveness in one community whereas reducing the fire incident rate may define effectiveness in another. The closest representative of a standard or common practice was the relatively consistent use of certain performance measures such as fire incident rates with population sensitivity and rates of fires in uninspected versus inspected occupancies for a given type (Ammons 107; Hatry 82). In addition, these performance measures were consistently noted in responses to the inspection survey.

Regarding academically promoted practices, the same shortage of recognized methods exists. Research discovered a position paper outlining a fire prevention effectiveness model published by the Ontario Fire Marshal. The paper was formatted to resemble a teaching or instruction outline similar to that used by lecturers to discuss major points on a particular subject matter. In the section titled Program Evaluation Components, the paper generally defines goals and objectives as well as measures organizations might use to support the accomplishment of

meeting an objective. For example, one objective required the organization to provide an indication that the inspection program was responsible, in whole or in part, for fire loss reductions. One could achieve this objective by a thorough fire incident evaluation of all fires in properties subject to inspection. This particular evaluation component or measure and the methodology to evaluate fire incident rates over periods of time, follows previously stated evaluation practices cited by Ammons, Hatry, and fire inspection survey respondents. Other evaluation component or measures include incidence of compliance within a specified time, incidence of continued compliance and incidence of voluntary compliance by inspected properties (Final Report on City Services 289).

The author reviewed National Fire Protection Association (NFPA) Standards 101, Uniform Fire Code and NFPA Standard 1031, Professional Qualifications for Fire Inspector and found no references to specific methods for evaluating fire inspection effectiveness. In addition, the author reviewed the International Fire Code which is the model fire code adopted by the North Carolina Building Code Council and found no references for evaluating fire inspection effectiveness.

In Ott's 2001 applied research project titled, *Analyzing and Evaluating a Fire Department's Inspection Programs for Efficiency and Effectiveness*, he discussed several practical principles based on four measurements of effectiveness that included (a) quality, (b) productivity, (c) efficiency, and (d) satisfaction. Ott defines quality as meeting customer's needs and expectations. With respect to efficiency and productivity, Ott contends that a large number of inspections accomplished doesn't mean that an inspection program is effective. Departments often get caught up in a numbers game, where importance is placed on whether the inspections completed instead of whether the inspections met their intended goals (Ott 59).

Ott discusses outcomes, or the consequences of [one's] actions, in order to tell whether a program accomplished what it was intended to do. Ott cites Ronald Coleman, John Granito, and Harry Carter in that a [inspection] program needs a method of self-analysis and an effective record keeping system and it is the program manager's responsibility to ensure these processes and resources take place in order to assess program outcomes (Ott 60). Lastly and with little justification, Ott states that employee [firefighter] satisfaction is yet another indicator for inspection program effectiveness. Ott's results generally follow those effectiveness measurement concepts identified previously where results are evaluated and reported on an organization's ability to meet its business purpose and not its workload or activity numbers.

Research by the author examined another applied research project from Kenneth Wood. His 1999 submission titled, *Evaluation of the Effectiveness of Fire Prevention Enforcement by the Office of the Illinois State Fire Marshal*, presented findings on three points central to this research.

First, citing a 1979 Schaenman, Hall, Schainblatt, Swart, and Karter study, *Procedures for Improving the Measurement of Local Fire Protection Effectiveness*, Wood reports that no satisfactory method has been available to measure the effectiveness of such [fire prevention] programs in preventing fires. There has been no way to know whether increased resources, often sought for these programs, would produce the desired results. Again, the perceived dilemma and subsequent question of how does one measure something not happening presents itself in current problems for organizations like the Cary Fire Department and in a 1979 study of fire protection effectiveness.

Second, the Schaenman et al. study found that the only absolute method for determining the effect of fire prevention enforcement is to analyze the fire experience in occupancies for

years before an inspection program is instituted, and then at some time after it has been in place. In this instance the study is primarily concerned with establishing causality and the solution appears to carry a reporting and analysis burden for year prior to implementing an inspection program.

Third, Wood discussed that the Schaenman et al. study noted that a fire prevention inspection program may reduce fire rates in ways that are not sensitive to the frequency of inspections. Through prospective public concern generated when inspections are conducted periodically, a continuing level of awareness for fire prevention activities and corresponding action actually increases. Again, the effect is assessed by comparing fire incident rates before and after an inspection program is instituted or by comparing similar communities with and without inspection programs.

A method for measuring the effectiveness of fire inspections for the Austin, Texas Fire Department was presented by Kevin Baum in a 2002 National Fire Protection Association Journal article, titled *Formula for Success*. In 2002, Austin Fire Department had no legal mandate to inspect existing structures, but had voluntarily conducted inspections of these properties, referred to as in-service inspections, for twenty years. As Baum states, Fire Department officials “thought” they were making a difference, but their in-service inspection program lacked a methodology and the program devolved into a numbers game (Baum 1).

The Austin Fire Department’s definition for fire inspection effectiveness is based on the premise that even the most ambitious fire inspection program can’t prevent all fires, but it can control their magnitude. Moreover, the Department noted that their approach to choosing occupancies [buildings] for inspections was inconsistent, emphasizing quantity rather than quality. Baum reported that Austin needed to develop a consistent model of risk [for

occupancies] and apply to historical incident data (Baum 1). Austin's realization closely follows Weil's research into OSHA's targeting process aimed at selecting construction worksites for OSHA inspections that would result in the most significant outcome for making workplaces safer and reducing work related injuries, illnesses, and deaths.

Austin's model and definition concedes that fire will occur in inspected properties, so mitigating the magnitude for those fires that occur served as the inspection's primary objective. In fact, Baum states that one must recognize that a hostile fire in an inspected property isn't just accepted, it's expected, even inescapable. Given this assumption, the challenge is to develop a model that determines whether the inspection efforts affect the magnitude, not occurrence, of these events over time.

Baum presents Austin's risk formula that is applied to various occupancy classes. Specifically, the formula is $R = F(C) + F(D)/P$. Where "R" is risk, "F(C)" is frequency of fires times the number of casualties, "F(D)" is the frequency of fires times dollar loss in millions, divided by "P" is population in thousands. Inspection success is inferred based on the risk value, "R" and the following changing conditions: a) does R decrease over time while the number of fires remains constant, b) does R remain constant while the number of fires increase, or c) does the risk value and the fire frequency decrease, while the population increases (Baum 2).

To supplement the statistical model, Austin introduced a post-incident inspection program that sends an inspector to every multifamily residential fire to determine what inspection efforts took place before the fire event, determine whether identified hazards were corrected and determine whether the previous inspection efforts had a measurable impact on the size and spread of the fire.

In summary, the Austin Fire Department inspection effectiveness model is a comprehensive effort that utilizes preplanning data to assess occupancies with the greatest risk, to identify properties most deserving of an inspection, a post-incident inspection for properties that experience a fire and longer-term analysis of incident data to monitor various trends for all variable factors.

As previously noted, David Ott suggested employee satisfaction is an indicator of effective inspections. Additional literature review confirms that measuring satisfaction does serve as an indicator of effectiveness. In the text, *How Effective Are Your Community Services?* authors Hatry, Fisk, Hall, Jr., Schaenman and Snyder address the concept from a citizen satisfaction perspective. When measuring fire protection outcomes, Hatry et al. suggests citizen satisfaction as a proxy measure for fire protection success. Typically, public opinion of firefighters and their work is generally quite high, therefore any dissatisfaction among citizens might signal problems within the organization (Hatry et al. 82). In addition, Sparrow states that regulators should monitor customer or client satisfaction, although they should avoid lumping together the opinions of enforcement targets with the opinions of complainants or others (308). Relating this process to fire prevention inspections, customer satisfaction surveys distributed to owners and operators for businesses subject to fire inspections would yield qualitative feedback on the inspector's thoroughness, command of the fire code and ability to successfully motivate the occupant to correct violations in a timely manner.

In addition to this qualitative evaluation method, Hatry et al. identifies a quantitative performance measure intended to assess the effectiveness of fire inspection efforts. Specifically, the percentage of fires in which the affected property was inspected within the last 12 months prior to the fire for all occupancies and by property type, assumes that a recent inspection should

reduce fire risk. In addition, one would also assume fire inspections reduce fire severity and improve occupant survivability. Therefore one would also assess fire casualties and property damage for those properties inspected within the last 12 months prior to the fire (Hatry et al. 88).

The researcher explored other evaluative methods for inspection effectiveness as part of the interview with Dr. Ammons. During his interview, Dr. Ammons identified four specific performance measures that fire departments utilize to define and measure fire inspection effectiveness. They include: (a) compliance with an inspection frequency schedule, (b) business or owner compliance with corrective orders issued by the inspector, (c) compliance with corrective orders within a prescribed period of time and (d) voluntary compliance with corrective orders within a prescribed period of time. Typically, when collecting performance measurement data, the fire department would benchmark or compare its measures against other departments with similar demographics, usually as part of a formal benchmarking report or study.

In his interview, Dr. Ammons stated that fire departments typically compare trends in performance measures over time and compare rates of change for those measures from year-to-year. In addition, departments report performance measurement data, in this case effectiveness measures for fire inspections, in their budget document or in separate performance measurement reports like the *Annual Performance Measurement Report* produced by the University of North Carolina's School of Government.

Currently, the Cary Fire Department collects various data such as workload or activity measures, efficiency and effectiveness measures and reports those measures in the North Carolina local government performance measurement project and Town of Cary annual budget document. The Department is accustomed to the administrative process of collecting compiling, assessing and reporting data and measures to demonstrate the efficiency and effectiveness of its

programs. However, the specific principles, concepts and measures identified by this research project represent a different focus for the Department. This redirected focus is likely to result in new principles, concepts and measures to demonstrate the effectiveness of the Cary Fire Department fire prevention inspections.

Procedures

As stated in the introduction, the author utilized descriptive research to identify a methodology to assess and report fire inspection effectiveness. For this research, the author performed a literature review of books, reports, Internet and journal articles. In addition, the author conducted a survey among various fire departments and interviews with noted experts and an employee work group within the Cary Fire Department.

Procedures

While attending the LCRR course at the National Emergency Training Center (NETC) in January 2008, the author performed an automated literature search for related texts and applied research projects (ARPs) and consulted with staff for related documents at the Learning Resource Center (LRC). This research produced two ARPs cited in this research project that provided information to answer research question 2.

During the period of June through August 2008, the author conducted multiple Internet searches using the Google search engine in an attempt to locate books, reports or manuscripts relating to fire inspection effectiveness, OSHA inspection effectiveness, and loss prevention effectiveness methods. This research produced 5 documents cited in this research project that provided information to answer research questions 1, 2 and 4.

When discussing the author's ARP proposal with assigned evaluator Richard Williams on June 22, 2008, Mr. Williams recommended the book, *The Regulatory Craft – Controlling Risks*,

Solving Problems, and Managing Compliance written by Malcolm Sparrow. Reading selected chapters of this book provided information to answer research question 1.

On August 8, 2008, using an online survey website found at www.surveymonkey.com, the author created and distributed a nine question survey designed to solicit and provide answers from other fire departments for research questions 1 and 2. Appendix C contains the survey questions. The survey randomized all possible answers to questions 1, 2, 3, 4 and 5 in order to eliminate any bias for the respondent's answers. In addition, survey questions 1, 3, 4 and 5 allow multiple responses, therefore the number of responses and their percentages do not necessarily equal the number of respondents.

The author distributed the survey's internet hyperlink http://www.surveymonkey.com/s.aspx?sm=gV8BU_2bzO_2b7HTj6ftDrcVfw_3d_3d to the following groups: (a) the North Carolina Metro Fire Departments, a coalition of 21 fire departments in North Carolina serving communities with populations greater than 25,000 people, (b) the North Carolina Fire Service Yahoo Group, an internet email group supported by the search engine and email provider, Yahoo. This group maintains a distribution list of approximately 400 career and volunteer fire officials in North Carolina, (c) the author's EFO Executive Development class of 24 fire officials representing 23 departments across the United States, (d) the author's EFO LCRR class of 16 fire officials representing 16 departments across the United States, and lastly (e) an email distribution list of 440 NFA EFO graduates and current students found on a separate ARP survey request received by the author. Based on the number of possible recipients, the author estimates approximately 400 fire officials received the survey hyperlink and request to complete the survey. The author estimates approximately 900 persons total received the survey link and

request to complete the survey. Forty eight respondents completed the survey representing a 5% response rate.

Given the relatively low response rate, the author recognizes the following potential limitations:

1. For the North Carolina Yahoo distribution list, the author estimates 250 of the recipients represent volunteer fire departments and likely do not conduct fire prevention inspections because in North Carolina, conduction fire inspections is a local government responsibility and function. Therefore, the survey would likely apply to only 150 recipients of this distribution list. Assuming this reduction of 250 recipients and resulting recipient total, 7.3% probably better represents the response rate.
2. Assuming that recipients from the NFA EFO distribution lists receive as many survey requests as the author does, one is not likely to respond to all survey requests received. The author only responds to those surveys premised on an issue of significance to the author and theorizes this may hold true for other EFO participants as well.

The survey asked four questions designed to identify similarities or parallels among the survey respondents and the Cary Fire Department relating to the broader fire inspection environment.

Survey question number 1 asks what decision or factor drives the organization to conduct fire inspections. Thirty seven, or 77%, of the forty-eight respondents indicated that an ordinance or statutory mandate caused the department to perform fire prevention inspections. The Cary Fire Department performs fire prevention inspections as a result of a statutory mandate and therefore aligns with the majority of respondents for this question.

Secondly, the Cary Fire Department serves a population of more than 130,000 people. Three respondents, or 6%, indicated they served a population within the range of 100,000 and 150,000 people. Eight, or 17%, of respondents indicated they served populations greater than 150,000 people. Sixteen, or 34%, of respondents indicated they served populations within the range of 50,000 to 100,000 people. Twenty, or 43%, of respondents indicated they served populations of less than 50,000 people.

Thirdly, inspectors employed by the Cary Fire Department must be certified by a state regulatory agency. Like the Cary Fire Department, thirty-eight, or 81%, of the respondents indicated a regulatory agency required their fire inspectors to maintain fire inspector certification.

Lastly, in an effort to assess how widely the survey instrument was distributed, survey question 7 asks for the state where the respondent's fire department is located. Table 1 summarizes the number of respondents from each state.

Table 1

Location of Survey Respondents by State

<u>State</u>	<u>Respondents</u>
NC	17
FL	3
MO	3
WA	3
CO, IL, MI, NH, NV, OR, and VA	2
AZ, CT, GA, IN, MS, TN, WI, and WV	1

Respondents from nineteen states participated in the survey. This level of survey participation indicates widespread representation among respondents.

On August 26, 2008, at 3:30 P.M., the author met and interviewed Dr. David Ammons, an Albert Coates Professor of Public Administration, at the University of North Carolina's, School of Government. Having authored 6 books relating to public administration, 3 of which specifically related to assessing local government performance, Dr. Ammons is regarded as an expert in the area of performance measurement, benchmarking and assessing local government performance. Appendix A contains the 9 interview questions posed to Dr. Ammons. The author designed the interview questions in order to elicit answers to research questions 1 through 4 and to contrast concepts presented in Dr. Ammons' book, *Municipal Benchmarks – Assessing Local Performance and Establishing Community Standards* to concepts presented in Harry Hatry's et al., *How Effective Are Your Community Services?* and Malcolm Sparrow's, *The Regulatory Craft*. In response to the author's email request for an interview, Dr. Ammons had recommended the Hatry et al. book as a possible reference for this research. For the purposes of this research, the author borrowed the Ammons and Hatry et al. books from the Town of Cary Public Works Director.

On September 17, 2008, at 9:00 A.M. the author met and interviewed Dr. James Porto, Dr. John Staley and Ms. Mary Alice Nocera, MSN at the University of North Carolina, School of Public Health, Injury Prevention Research Center. Dr. Porto is a Clinical Assistant Professor and Director of the Executive Master's Program for Health Policy and Management. He specializes in measuring efficiency and effectiveness in public organizations and comparative evaluation methodology. Dr. Staley serves as a Postdoctoral Fellow with responsibilities for injury and violence prevention and workforce safety and youth violence outcomes. Maryalice Nocera,

MSN, is responsible for project management to include outcome evaluation for traumatic brain injury in children and workplace violence. Using questions found in Appendix B, the author conducted the interview in the form of a panel discussion eliciting various evaluation methods to assess the effectiveness of loss prevention activities. Given their academic and experiential backgrounds for evaluation methodology and risk or loss prevention research, the panel was particularly suited to answer research question 1.

On September 19, 2008, at 3:00 P.M., the author met and conducted a panel discussion with Cary Fire Department Fire Marshal Ken Hawley, Deputy Fire Marshal Rick Hall and Senior Fire Code Official III Donald Ayscue. As Fire Marshal, Ken Hawley is directly responsible for administering the fire inspection program for the Town of Cary. Hawley collects, assembles, and analyzes inspections data for various administrative purposes including developing performance reports to include in the department budget and annual performance measurement report. Deputy Fire Marshal Rick Hall is responsible for certificate of occupancy inspections and supervises 1 fire inspector. Senior Fire Code Official III Donald Ayscue is the Department's most senior fire inspector. Given their departmental experience and daily administrative and inspection responsibilities, this panel is particularly suited to provide responses and perspective for research question 5. The author presented an overview of this research and its purpose and asked participants to identify and report any barriers to implementing a method to assess the effectiveness of fire prevention inspections in order to answer research question 5. The panel presented their findings to the author on September 22, 2008, by email.

Limitations

For research questions 1 through 4, the author discovered relevant and sufficient sources of written information found on the Internet and in book form as well as expert subjects to interview. However, this did not hold true when conducting the survey. For example, in summarizing responses for the survey question asking for departmental definitions for inspection effectiveness yielded one definition per department, demonstrating that a consensus definition did not exist. In addition, the low survey response rate was a limiting factor.

Another surprising limitation arose during discussions with Cary Fire Department inspections staff. Even within this specific workgroup there was significant variation among individual responses to research question 5 and the discussions that followed. Barriers identified by the group included (a) the Fire Department and Town Manager's, need to agree upon a clearly stated definition for fire inspection effectiveness, (b) the current records management system (RMS) captures some data from which analysts can develop limited performance measures; however, the organization is replacing that RMS. As such, with a new definition for effectiveness the Department will need to review and revise performance measures for the new RMS, (c) with new effectiveness measures, the Department will need to review and revise current inspection work processes to ensure those processes align with new effectiveness measures, and (d) given the infrequent and limited reporting mechanism for programs, the Department would need to develop and implement a comprehensive annual report for all programs.

Definition of terms

Benchmarking – Comparing anticipated or desired performance results anchored either in professional standards or in the experiences of respected organizations (Ammons 22).

Counterfactual thinking – Is the process of using “what if” scenarios to think about situations that did not happen and their implications.

Fire prevention inspection – An on-site check of a property conducted by a fire inspector and using a fire code as the standard.

Leading Community Risk Reduction (LCRR) – Is the second course of the National Fire Academy Executive Fire Officer Program series. The focus of this course is to enhance the skills needed by an Executive Fire Officer (EFO) to implement a community risk reduction initiative (Leading Community Risk 15).

Loss prevention – Activities designed to reduce or eliminate personal or property damage, harm or deprivation.

Performance measurement – Is the term often applied to the collection and analysis of data or feedback on local government operations (Hatry et al 1).

Sensitivity analysis – Is used to ascertain how a given model output depends upon the input parameters.

Stakeholder – A person, group or party affected by the decision of another.

Results

The author’s literature review and interviews provided a broad range of results to research question 1, “How do organizations that utilize inspections for loss prevention define and measure their effectiveness?”. In his book, *The Regulatory Craft*, Sparrow creates a framework of concepts and ideas by which one should use to define effectiveness for the organization and

the challenges associated with its ongoing analysis. The central concept is that the organization should assess and report on its “business purpose”. Sparrow asserts regulatory agencies should not be overly concerned with proving causality. Conversely, they should be content to publicly demonstrate their ability to identify specific risks, design and implement creative solutions, assess whether the risk was abated and then move on to a new risk problem. Moreover, Sparrow suggests credit cannot be assigned to one functional group and that even measuring compliance rates is a difficult task. In summary, Sparrow suggests that effectiveness is best measured and reported by identifying specific risks or problems, solving those problems with specific strategies and then reporting those activities with anecdotal examples.

In the Grey-Mendeloff study, their evaluatory methodology centered on an outside party using multiyear data to assess and make conclusions regarding the effectiveness of the regulatory agency, OSHA, to reduce injuries in the manufacturing sector. This article contained examples of process and outcome evaluation based on complex statistical analysis for data sets covering several years. Evaluating effectiveness in this example is premised on independent review of specific data for a specific sector.

The Weil study uses the Sparrow methodology to identify a specific risk, create and employ strategies to respond to that risk and then assess whether the strategy abated the risk. Weil proposes making OSHA inspections more effective in the construction sector by targeting specific construction job sites at times of construction activity that typically have the greatest risk of injury and death. In addition, Weil suggests targeting worksites of particular contractors that would yield the greatest compliance with the inspection itself. Weil’s evaluation would not center on illness and injury measures for this sector, but on measuring the effects of injury and illness risk exposure and the lasting deterrent effects.

The Ammons interview yielded a simple yet practical answer to the question, “How do loss prevention organizations measure their effectiveness?” Ammons’ answer is that one would want to see a reduction in the rate of occurrence of the loss activity and benchmark your measure or rate against what others are achieving. This methodology is applicable to fire prevention inspections as well and based on its simplicity and widespread use, suggests that this methodology is likely viewed as a common practice within the fire service.

Lastly, the interview with Dr. Porto, Dr. Staley and Ms. Nocera suggested two evaluation methods used by public health loss prevention researchers that parallel processes and outcomes used in fire prevention inspections. First, the group suggested a process evaluation method using the process of conducting fire inspections as the subject of evaluation. Specifically, an evaluator would compare each task or activity used to conduct a fire inspection to generally accepted practices or departmental guidelines. Secondly, the group suggested an outcome evaluation method that compared the costs of conducting fire prevention inspections compared to the costs of a fire event that might likely occur if the inspection was not conducted.

In responding to the second research question, Dr. Ammons indicated there were no national standards or academically promoted practices for assessing fire inspection effectiveness. The literature review revealed similar results. The author examined NFPA 101, NFPA 1031 and the International Fire Code and found no references to a national standard or academically promoted practice for assessing fire inspection effectiveness.

The researcher’s literature review, interview and survey provided results to research question 3, “How do fire departments typically define and measure the effectiveness of fire inspections?”

Whether intended or not, Ott's results generally follow those effectiveness measurement concepts identified by Sparrow, where results are evaluated and reported on an organization's ability to meet its business purpose and not its workload or activity numbers. Ott provides a candid assessment of his department's motivation for conducting inspections and that is to generate activity numbers because activity level was the parameter used for the evaluation. Ott's findings also presented subjective evaluative criteria such as employee satisfaction and quality (Ott 30).

In Kenneth Wood's applied research project, he found that the only absolute method for determining the effect of fire prevention enforcement is to analyze the fire experience in occupancies for years before an inspection program is instituted, and then at some time after it has been in place. Wood also noted that the effectiveness of fire inspections may also result from a businesses prospective concern for an inspection and is not necessarily sensitive to the frequency of the inspection (Wood 34).

In the article, *Formula for Success*, author Kevin Baum reviews the methodology the Austin, Texas Fire Department uses to define and evaluate fire inspection effectiveness in specific occupancy types. Austin's Fire Department's method is based on the statistical model, $R = F(C) + F(D)/P$, where R equals risk for a specific occupancy, F equals the number of fires in that occupancy, C equals the number of casualties in that occupancy, D equals the dollar loss in millions for that occupancy and P is the population in thousands. Using this formula for all occupancy types, Austin identifies specific occupancy classes on which to concentrate fire inspection resources. Once the inspection process has begun, Austin then recalculates the risk factor and evaluates for any trend in risk that may have developed. If the risk factor decreases

over time, then the inspection process is deemed effective. Conversely, if the risk factor increases over time, then Austin conducts additional analyses to understand why.

In addition to this risk assessment, Austin conducts a post-incident inspection to determine (a) what inspection efforts took place before the [fire] event, (b) determine whether identified hazards were corrected, and (c) evaluate if the previous inspection efforts had a measurable impact on the size and spread of the fire (Baum 3).

Therefore, the Austin Fire Department's definition of an effective fire inspection program is a declining trend for the risk of a particular occupancy. In addition, when fires do occur, the Austin Fire Department assesses effectiveness by performing a post-inspection quality check on the previously conducted inspection.

The Ammons interview indicated that fire departments typically report measuring fire inspection effectiveness by virtue of the following performance measures (a) assessing the percentage of compliance with an inspection schedule, (b) business compliance rate with making ordered corrections, (c) assessing compliance with ordered corrections for violations within a specified number of days, and lastly, (d) voluntary compliance within a specified number of days.

The author conducted an inspection survey in which officials from 48 fire departments responded to questions about how fire inspection effectiveness was assessed in their organizations. The inspection survey yielded widespread results for the fourth research question.

When asked how departments defined and measured fire inspection effectiveness, 48 departments responded with 14 definitions and measures. However, the reality is that those departments were not that close in their responses because 21 departments indicated that they do not define effectiveness or they have never thought about defining effectiveness. For those

departments that have identified a definition, they utilized activity or workload measures and some outcome trends to define effectiveness. Many respondents submitted multiple responses to the question illustrating the difficulty of settling on a common definition which made summarizing all of the responses difficult. Table 2 summarizes the most frequently cited responses.

Table 2

Frequency of Responses for Definition of Fire Inspection Effectiveness

<u>Definitions</u>	<u>Responses</u>
No definition	13
No consideration	8
Reduction of fires	5
Violations cited	5
Fires in inspected properties	4
Number of inspections completed	3
Reduction in re-inspections	3
Performance measures	2

Of the most frequently cited definitions violations cited and number of inspections completed represent activity levels and as previously noted, do not illustrate or denote effectiveness. However, reduction of fires, fires in inspected properties, and a reduction on re-inspections, represent trends for the business purpose of the inspection group and therefore serve as better examples for demonstrating effectiveness. Nine other definitions were submitted, some of which denoted activity levels and others better illustrated measures directly related to the business purpose of the group. However, no more than two respondents used any one remaining

definition. Moreover on their individual merit, none of the responses represented a definition that would warrant special consideration to report in this summary.

When asked to describe the method by which fire departments evaluated effectiveness for fire inspections, the author found more consistent responses than those reported for the definition question. Again, participants reported multiple responses to this question; therefore, the survey reports more responses than respondents. Table 3 summarizes the most frequently cited methods by which fire departments evaluated fire inspection effectiveness.

Table 3

Frequency of Responses for Evaluation Method for Fire Inspection Effectiveness

<u>Evaluation method</u>	<u>Responses</u>
Compare current period measures to measures from a previous period	20
Review trends for measures over time	20
Review specific problems solved in a period	20
Do not evaluate effectiveness	4
Performance measurement/benchmarking project	4

The three most frequently cited methods (a) compare current period measures to measures from a previous period, (b) review trends for measures over time, and (c) review specific problems solved in a period illustrate a consistent evaluation method by most departments as well as following methods previously cited by recognized experts or related publications. The last multiple respondent group indicates fire departments evaluate inspection effectiveness by participating in and comparing data in a group performance measurement and benchmarking project. Five additional methods were reported in the survey. However as with

definitions, no more than two departments participating in the survey used any one remaining method. Moreover on their individual merit, none of the responses represented a method that would warrant special consideration to report in this summary.

In his interview, Dr. Ammons indicated that departments or administrators that value efficiency and high performance organizations assess their performance measures at least annually. One of the survey questions asked departments how they assessed inspection effectiveness and reported the results to others. Survey results indicate there are several methods, many used in combination that fire departments use to assess fire inspection effectiveness. Twenty of the forty eight respondents indicated they used one or all three of the following methods to assess fire inspection effectiveness: (a) departments compared performance measures for the current period to the same measures of a prior period, (b) departments reviewed and tracked trends for performance measures over time and (c) departments reviewed specific problems which were corrected over time. In addition, thirteen respondents indicated a variety of other responses to the question. Specifically, five respondents indicated their department simply did not assess fire inspection effectiveness. Three respondents indicated their department reported performance measures in a benchmarking study. Two departments utilize customer satisfaction surveys as a method to assess inspection effectiveness. One respondent indicated their department reviewed performance measures internally. One respondent indicated their department's fire marshal audits their fire inspections with a follow-up inspection, which corresponds as a method identified by Dr. Ammons during his interview. Lastly, one respondent indicated their department tracks the number of inspections conducted as the method used to assess effectiveness.

The Ammons' interview indicated that fire departments typically report program effectiveness measures, like those for fire inspections, in their annual budget document. In addition, some departments participate in performance measure studies and departments may submit performance measures for the final study report. Typically, the budget document is public record and therefore available to anyone upon request. However, many times only certain interested parties seek the reports and read the results. As such, the general public is less likely to read and assess a program's performance as cited in the report.

Results from the fire inspections survey indicated that fire departments report fire inspection effectiveness to several audiences and at various times. Forty-three respondents indicated their fire departments report fire inspection effectiveness most frequently to the local government administration. Twenty-six respondents indicated their department reported fire inspection effectiveness to the local governing board, and 18 respondents report to a state regulating agency. Conversely, 17 respondents indicated their fire departments do not report inspection effectiveness to the inspections group or fire department itself. Fifteen respondents do not report to a state regulatory agency and 12 respondents do not report to the public. Table 4 summarizes responses for the survey question "To whom and how often does your department report inspection effectiveness?"

Table 4

Summary of Responses for Recipients and Frequency of Effectiveness Reports

Inspection group/fire	Monthly			
	As needed	or quarterly	Annually	None
department	10	9	5	17
Administration	6	25	18	3
Governing board	7	16	10	9
State agency	8	6	12	15
Public	10	1	13	12

In the course of answering the fifth research question, “What barriers exist to implementing a method to assess fire inspection effectiveness in the Cary Fire Department?”, inspections staff identified four barriers to implementing a method to assess fire inspection effectiveness. These included: (a) defining fire inspection effectiveness for the organization, (b) configuring a new records management system to capture data that relates to the new definition, (c) evaluate work processes to insure they align with the new definition and data needs, (d) creating an annual report for all fire department programs, including fire prevention inspections.

Discussion

In *The Regulatory Craft*, Sparrow creates a framework of concepts and ideas such as his five inescapable truths for measuring effectiveness (a) aggregating outcome measures, (b) proving causality, (c) assigning credit, (d) measuring prevention and (e) measuring compliance rates (Sparrow 285) are neither too scholarly nor too pragmatic. Sparrow’s ideals establish a

plausible and reasonable framework on which to build an agency's evaluation and reporting system.

The Gray-Mendeloff report represents a third party assessment from data published by a regulatory agency. The report is long-term statistical analysis for a specific target. It makes no presumptions that effectiveness extends to other regulatory targets or not. The report and assessment provides a methodology to assess effectiveness, but for fire inspections, the methodology would essentially ask if inspections were effective for one type of occupancy. While the Grey-Mendeloff study does assess the effectiveness of OSHA inspections, this particular methodology is not well-suited for regularly assessing the effectiveness of fire inspections and reporting those results on a regular basis.

The Weil analysis is yet another third party assessment based on OSHA data. Like Sparrow, Weil's methodology utilizes a specific problem approach, but utilizes a complex set of retrospective analysis and prospective deterrent effects. Like the Grey-Mendeloff study, Weil's method does establish a plausible framework and process to assess the effectiveness of OSHA inspections, but is not particularly suited for assessing the effectiveness of fire inspections and reporting results on a regular basis.

The researcher found President Clinton's speech provided appropriate detail for the vision and direction for a new Occupational Safety and Health Administration. Clinton states that OSHA should be evaluated, "on the basis of data and actual results achieved" (Clinton 7). This criteria aligns with Sparrow's theory that one should evaluate a regulatory agency based on the business results achieved (Sparrow 281).

Dr. Ammons' contributions to this research reflect simple, plausible and common suggestions because his academic work centers on this very subject matter. Through his

experience and research on this topic he has eliminated those methods that are tedious time consuming and complicated to conduct and analysis in order to answer most citizens' concern: assurance that programs are meeting intended goals. Using various performance measures that most all responsible fire departments already collect, thereby not burdening them, managers provide simple outcome measures in a manner in which fire practitioners and the public can easily understand and to which they relate the desired outcome of reducing fires, their magnitudes and damages. While not wholly scientific or based on long-term data, Ammons' method answers the effectiveness question by making a plausible case that the activity measured is meeting its intended purpose. An idea contended by Sparrow (288) and Porto (personal communications September 17, 2008) as well.

The two evaluation methods suggested by the Porto et al. interview fall into two categories (a) process evaluation and (b) outcome evaluation (personal communications September 17, 2008). One suggests evaluating the fire inspection processes by comparing steps within the inspection process to recognized standards or operating guidelines. The second evaluation method suggests evaluating the effectiveness of fire inspections by virtue of a cost comparison using actual costs to implement the inspection program with the anticipated costs of fires and resulting damages likely to occur if the inspections program were not in place (Personal communications). Both evaluation methods would in fact offer a plausible assessment of whether fire inspections were effective. However, these methods do not lend themselves to regular review and assessment. Their evaluative functions relate more to a program audit that assesses effectiveness in a holistic manner and fails to address ongoing trends for specific outcomes measured by most fire departments.

For example, although a process evaluation may conclude that an inspector or group of inspectors utilize correct procedures during the inspection itself, it fails to assess whether the number and magnitude of fires and resulting damages decline or whether an occupant actually corrects a violation cited by the inspector within a certain time period. Of course, the cost benefit evaluation method assesses and establishes program effectiveness strictly on a monetary threshold. It presents the question: Do the benefits of conducting fire prevention inspections outweigh the costs of not conducting fire inspections? Implicit to the question is the assumption that fire prevention inspections will produce an expected outcome such as, reducing the incidence and magnitude of fires and resulting damages. As noted in the Background and Significance of this research, the Department is unable to demonstrate the effectiveness of fire inspections thereby undermining its ability to ask others, namely those responsible for departmental funding decisions, to assume that fire inspections do in fact satisfy their intended purpose. Until the Department is able to demonstrate at some plausible level that inspections do satisfy their intended purpose, those evaluative methods premised on some association with outcomes will likely convey greater credibility than evaluative methods premised simply on cost of projected consequences.

In his applied research project, David Ott described various quantitative and qualitative evaluative criteria for fire inspection effectiveness. Specifically, Ott cited (a) quality, (b) productivity, (c) efficiency and (d) satisfaction as four measures of effectiveness with quality identified as the most important of the criteria (Ott 58). He never directly relates quality as an effectiveness measure, but instead simply cites R. Robertson's, *Introduction to Fire Prevention*, that thoroughness cannot be overemphasized and while personnel in his department conduct many inspections, they are hurried and not thorough (Ott 58). In another example, Ott contends

that employee satisfaction is a measure for fire inspection effectiveness (Ott 61). He states that if an organization properly trains inspections staff and appropriately supervises the fire prevention program, employee satisfaction would improve and by association inspection effectiveness would improve. Sparrow also contends that regulators should monitor employee satisfaction, to ensure that work is meaningful, challenging, and rewarding (Sparrow 308). Hatry, et al. addresses the concept from a citizen's satisfaction perspective. When measuring fire protection outcomes, Hatry et al. suggests citizen satisfaction as a proxy measure for fire protection success. Typically, public opinion of firefighters and their work is generally quite high, therefore any dissatisfaction among citizens might signal problems within the organization (Hatry et al. 82). Relating this process to fire prevention inspections, customer satisfaction surveys distributed to owners and operators of businesses that receive inspections would yield qualitative feedback regarding how thorough and effective the fire inspector's effort was.

The author acknowledges Ott's review focused on company level staff tasked with fire inspections and monitoring employee satisfaction for this group is an ongoing consideration for most all fire department activities, this study found no other references to employee satisfaction as an appropriate evaluative method when assessing the effectiveness of any loss prevention activity. Sparrow does suggest that regulators should monitor employee satisfaction with regard to meaningful, challenging and rewarding work. So, while conventional wisdom dictates that if employees generally feel challenged with rewarding work, one can assume fire inspections will serve as effective regulatory activities. On the whole, Ott's literature review and discussion simply failed to adequately describe and justify the four criteria as useful evaluative methodologies and therefore do not significantly influence the results of this research.

In his research, Woods (1999) offers an outcome related evaluation method. His literature review of Schaenman et al. (1979) states that essentially the only absolute method for assessing the effects of fire prevention enforcement is to analyze the fire experience in occupancies for years before an inspection program is instituted, and then at some time after it has been in place. Wood's research examined the issue of causality as it relates to evaluating effectiveness by surveying state fire marshal agencies on their use of fire incident reporting data to establish fire inspection priorities (Wood 77). Specifically, Wood contends that fire incident data should dictate fire prevention inspection priorities. This strategy assesses effectiveness similar to Weil's targeting strategy for OSHA inspections. The targeting premise is to concentrate limited inspection resources on occupancies that represent the greatest need and would provide the greatest return for the resources invested. When concentrating on particular occupancy problems, evaluating effectiveness and establishing strong plausibility that the inspection activity is driving any changes in incident rates, becomes increasingly easier for the inspecting agency. Moreover, this methodology closely aligns with Sparrow's central focus for regulatory agencies, whereby agencies focus on solving specific problems with creative solutions; recognize when the risk was abated and then move on to new problems (Sparrow 288).

While the targeting strategy produces a specific problem on which to concentrate resources and focuses analysis on specific statistical data thereby establishing a higher degree of causality, the strategy fails to assess fire inspection effectiveness in a holistic manner. So while inspections for one occupancy class may show positive results, what degree of effectiveness does one assume for the occupancy classes not inspected?

Wood's discussion on inspection causality and incident rates presented data illustrating that a significant decline had occurred in the number of fires in many occupancy classifications

that were not inspected on any regular basis. Occupancies realizing declines in fire incident rates included: (a) industrial occupancies, (b) business occupancies and (c) college dormitories and Greek housing. Declining fire incident rate trends in the absence of fire inspection activity for these occupancies further illustrates the difficulty proving causality, just as Sparrow (287), Ammons and Porto (personal communications August 26 and September 17, 2008) have consistently indicated. Incorporating this “difficult to prove” causality principle into Wood’s prospective targeting methodology and conducting subsequent fire incident rate analysis establishes a very plausible method for evaluating fire inspection effectiveness. Expanding the fire incident rate analysis (Ammons personal communication August 26, 2008) to include all occupancy classes including those within the prospective targeting methodology and those not targeted would create a more complete evaluation methodology and assessment for most fire inspection agencies.

Baum (NFPA 1) states that one must recognize that a hostile fire in an inspected property is not just accepted; it is expected, even inescapable. Given this assumption, the challenge is to develop a model that determines whether the inspection efforts affect the magnitude, not occurrence, of these events over time. While the researcher disagrees with Baum’s word choice that fires occurring in inspected properties are accepted and expected, Baum does establish that fires outside of the fire inspector’s control do occur and hence are inescapable. Therefore, elements of Austin’s expectation that fires will occur seem appropriate as a basis for stating exactly what the Fire Department believes will happen, but also that fire prevention inspections will limit or reduce the magnitude of these fires and the resulting damages.

Baum’s model is based on risks in specific occupancies, in this case multifamily occupancies, and allows the Austin Fire Department to concentrate on specific fire problems

based on actual data with creative solutions just as Sparrow suggests by his definition of a risk control performance account. [The performance account] would look like: “a collection of stories, each one spelling out the nature of the problem, the method of its abatement, and the empirical evidence to show that the problem went away.” (291). Austin’s model presents itself as a very plausible alternative to the Cary Fire Department as a starting point for developing a methodology to assess fire inspection effectiveness.

A concern identified by the survey is the number of departments that do not evaluate effectiveness, although that number is significantly smaller than the number of respondents that indicated their department has no definition for inspection effectiveness or has not considered a definition. This begs the question that, “If twenty one departments have no definition for effectiveness, then how do all but four of those departments evaluate fire inspection effectiveness?”

Another limitation was the response rate, calculated at 5% minimum and 7.3% at best, clearly a low rate of response. As such, one cannot draw any firm conclusions. The responses did provide meaningful insight as to how fire departments perceived the issue of effectiveness for fire prevention inspections. For example, aggregating responses for defining various definitions for effectiveness after aggregating the responses for those departments that do not define the activity was nothing more than listing one example for each responding department. This proved a limiting factor when attempting to focus on responses to research question 3.

Regarding the methods used by fire departments to assess fire inspection effectiveness, the survey yielded eight different methods, used either singularly or in combination by forty three respondents. Five respondents indicated their department does not assess fire inspection effectiveness. The significant variation in methods used to assess fire inspection effectiveness by

respondents to this survey underscores the limited attention the subject is given in national fire standards and fire prevention codes. One would assume that when assessing effectiveness is important to a department, that department seeks specific performance measures, customer satisfaction surveys or some auditing method best suited for that purpose. Given the variation of methods and wide latitude in their uses, Sparrow's stated difficulty for aggregating outcome measures (286) holds true especially when benchmarking one department's inspection effectiveness against another.

For the one respondent in the survey that reported his/her department evaluates inspection effectiveness by the number of inspections completed, Ott (2001) found the following:

A large number of inspections accomplished doesn't mean that an inspection program is effective. Departments often get caught up in a numbers game and importance is placed on whether the inspections were completed instead of whether the inspections were effective in meeting their intended goals. (Ott 59)

Typically, a budget document is public record and therefore is available to anyone upon request. Organizations that produce final reports for performance measure studies typically distribute these reports only to participants or market them to interested parties. Typically, these reports are not widely distributed. As such, the general public or interested citizenry is less likely to read and assess a program's performance as cited in the reports.

Another surprising finding was the variation for definitions of inspection effectiveness including the overall purpose for fire prevention inspections among Cary fire inspections staff. Historically, the Department has reported two effectiveness measures, however, its staff was unsure if those measures aligned with the inspection function and in turn failed to properly assess effectiveness. Staff recognized that because the Department currently collected and analyzed

data and reported performance measurement based on that analysis, any changes resulting from that research simply represented revisions or updates to work already performed. Therefore, very few significant barriers existed. In fact, staff indicated widespread agreement that the current process for evaluating effectiveness did not provide a commensurate value return to the group; therefore, some process revision was needed.

In addition to providing responses to the fifth research question, staff also expressed thoughtful opinions on other research questions as well. In particular, one member responded to the question about how one defines an effective fire prevention inspection by stating:

An effective inspection is one that insures a building and the building's systems and equipment are in compliance with the Fire Code and when performing the inspection, educating the occupants about the fire code is essential. One would measure this effectiveness by assessing the compliance rate for correcting violations identified during the inspections and incorporating a quality control assessment, like an inspection audit conducted by a supervisor or more experienced inspector for the original inspection (Personal communication September 19, 2008).

This idea of an inspection audit was discussed during the interviews with Dr. David Ammons and Dr. Porto et al. and therefore appears to have merit as an acceptable practice.

Sparrow provides comprehensive reasoning for conducting random audits by stating:

The principal value of conducting audits is that they provide opportunity, over the long term, to redirect resources, to make invisible problems visible, to adjust selection and targeting systems, to target resources, and to select enforcement actions with the greatest impact on significant areas of noncompliance. (p. 290)

From a holistic perspective, one must concede that Sparrow's rationale here is the very essence of fire prevention inspection program effectiveness.

Recommendations

1. The author will distribute this research to the Cary Town Manager's, the Town's Budget Office and Cary Fire Department Inspections Group for their review and consideration.
2. Staff in the Cary Fire Department Fire Inspections and Administration Groups will develop and recommend a program definition for fire inspection effectiveness. In turn, the Fire Chief will present that recommendation to the Town Manager and Town Council for formal approval. This definition will serve as a program goal for the Inspections Group and Fire Department. At a minimum, the author would recommend that the definition include the concept of reducing the incidence and magnitude of fires as well as reducing the number and severity of fire related deaths, injuries and property damage.
3. Based on the aforementioned definition, Cary Fire Department staff in conjunction with Town Budget Office staff will develop new or revised performance measures in order to assess the Department's ability to meet its new program goal. At a minimum, the author would recommend one performance measure that examined the rate and magnitude of fires in occupancies where an inspection had been conducted according to the inspection frequency schedule and the rate and magnitude of fires in occupancies where an inspection had not been conducted according to the inspection frequency schedule.
4. With the advent of a new records management system (RMS), staff will incorporate any required data fields and new or revised performance measures into RMS development.

5. Cary Fire Department staff will request authorization from the Town Manager's Office to preparing an annual fire inspections effectiveness report that would be made available to the Governing Board and the public.

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Appendices

Appendix A

Interview Questions for Dr. David Ammons

University of Chapel Hill, School of Government

26 August 2008

3:30 P.M.

1. How do organizations that utilize inspections for loss prevention define and measure their effectiveness?
2. How do fire departments typically define and measure the effectiveness of fire inspections?
3. How do these departments assess that effectiveness and report it to others?
4. What national standards or academically promoted practices for assessing fire inspection effectiveness exist?
5. In your book, *Municipal Benchmarks*, you suggest that performance measurement in local government have a long way to go creating and using advanced PM systems. What has been the basis of that limited use and do you see any positive changes or evolutions to improve the use PM systems? (What barriers exist to implementing a method to assess fire inspection effectiveness in the Cary Fire Department?)
6. On page 18 of *Municipal Benchmarks*, where you discuss, You Can't Measure What I Do, Departments making this claim are often characterized by non-routine work and the absence of a data collection system. Both factors make measurement difficult. You say, "Rarely is it impossible". Harvard Professor Malcolm Sparrow asserts that because

risk control is problem specific and causality is usually impossible to prove, measuring prevention is difficult to support [with resources] over the long term. p.289

Also, in *How Effective Are Your Community Services?*, Hatry, p. 81 suggests that when measuring outcomes- fire prevented, fires suppressed, human life and property preserved are exceedingly difficult to measure. What performance measurement process or system do you suggest as a counter argument to Sparrows and Hatry's claim?

7. Assuming Sparrow and or Hatry are correct either mostly or theoretically what other "proxy" measure process or system would you suggest for a fire department attempting to measure the effectiveness of fire prevention inspections?
8. P. 107 – Table 12.11 *Effectiveness measures for Fire Services* includes "Inspection Effectiveness" as the specific measure for the "Rate of fires in inspected versus uninspected occupancies of a given type, or "frequently inspected versus infrequently inspected". On its face, the fallacy of the measure is the absence of causes for the fires. Certainly fires will occur as the result of causes not addressed by prevention codes e.g. arson, natural disasters and accidental. Do you consider that the rate of fires as a consequence of whether the occupancy was inspected or not as a sound basis for measurement? If so, why? If not, why not? How would one improve the measure?
9. What other research considerations would you recommend?

Appendix B

Interview Questions for Dr. Jim Porto, Dr. John Staley, and Maryalice Nocera, MS

University of North Carolina, Injury Prevention Research Center

September 17, 2008

9:00 A.M.

1. Given the similarity of fire prevention inspections to other public health injury prevention initiatives, what effectiveness assessment methods do injury prevention evaluators utilize that might apply to assessing effectiveness for fire prevention inspections?
2. How do injury prevention evaluators address causality for injury prevention initiatives when assessing the effectiveness of injury prevention initiatives?

Appendix C

Survey – Fire Inspection Effectiveness

The survey included the following questions:

1. Does your organization conduct fire prevention inspections by:
 - a. Virtue of an ordinance or statutory mandate?
 - b. Virtue of a self-initiated program choice?
 - c. Virtue of some other cause? Please describe.
2. How does your organization define fire prevention inspection effectiveness?
 - a. We don't.
 - b. We haven't thought about it.
 - c. Other. Briefly describe your definition.
3. Based on your definition, what criteria or data does your organization use to measure fire prevention inspection effectiveness?
 - a. The number of violations identified and corrected.
 - b. The numbers of fires that occur in property you inspect.
 - c. The number of inspections conducted by your organization.
 - d. Solving specific problems or risks in certain occupancies.
 - e. The compliance rate with an inspection frequency schedule.
 - f. Other. Please specify.
4. How does your organization evaluate or assess fire prevention inspection effectiveness?
 - a. Compare measures from a current period to measures of a previous period.
 - b. Review trends for measures over time.

- c. Review specific problems solved or corrected in a period.
 - d. Use some other evaluation or assessment process. Please describe.
5. To whom and how often does your organization report fire prevention inspection program performance?

	As needed	Monthly or quarterly report	Annual Report	No report
Public				
Local governing board				
Local government administration				
State regulatory agency				
Inspection group and/or parent organization				

6. Describe the population range for your jurisdiction.
- a. Less than 50,000
 - b. 50,000-100,000
 - c. 100,000-150,000
 - d. Greater than 150,000

7. Please complete the following contact information. No department or respondent name will be published or shared from this survey. However, contact information will provide a method for additional questions, if necessary. The state field is required.
 - a. Name:
 - b. Company:
 - c. Address:
 - d. Address 2:
 - e. City/Town:
 - f. State:
 - g. Zip/Postal Code
 - h. Country
 - i. Email address:
 - j. Phone number:
8. Does your state or jurisdiction require fire prevention inspectors to be certified by a regulatory agency?
 - a. Yes
 - b. No

9. Indicate how important defining, measuring, evaluating and reporting fire prevention inspections effectiveness are to your organization?

	Not important	Somewhat important	Important	Considerably Important	Very Important
Defining					
Measuring					
Evaluating					
Reporting					

Appendix D

Interview Questions for Cary Fire Department Risk Management Staff

September 19, 2008

1. How would you define when a fire prevention inspection was effective?
2. In light of some of the methodologies and assessment considerations the author's research has identified, such as, improperly using workload indicators as a performance measure for effectiveness and focusing on compliance with the State's fire inspection frequency schedule as an indicator for inspection program effectiveness, what barriers to you foresee should the department significantly revise its method to assess whether fire prevention inspections are effective at reducing the incidence and magnitude of fires?